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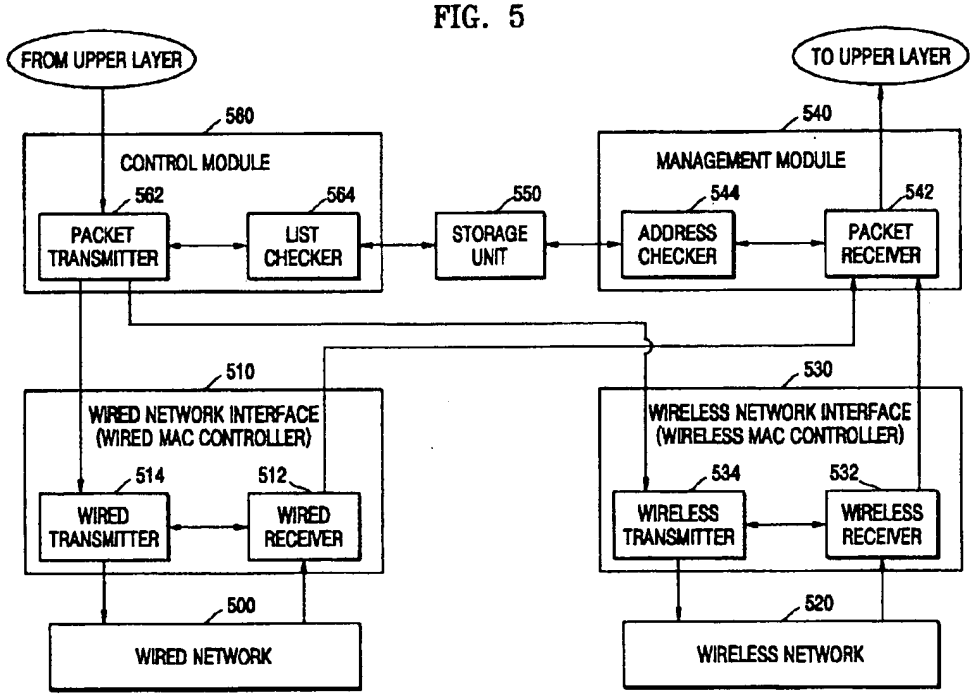
(54) A hybrid network controller

(57) A communication method for a hybrid wired and wireless communication system includes registering an entry comprising a physical address of a source transmitting a received packet and an identifier indicating a wired or wireless network interface linked to the physical address in a predetermined management list; receiving a transmission packet from an upper layer and determining whether a physical address identical with a destination physical address of the transmission packet is present in the management list; and when the destination physical address is present in the management list, transmitting the transmission packet through either of the wired network interface and the wireless network interface according to the identifier.

FIG. 5



EP 1 489 801 A1

Description

[0001] The present invention relates to a method and associated apparatus for controlling data transmission over a hybrid network having a wired and wireless part, comprising receiving data including a source identifier from a source over the hybrid n etwork.

[0002] As show in Figure 1, a hybrid wired and wireless communication system includes a central processing unit (CPU) 10, a read-only memory (ROM) 20, a random-access memory (RAM) 50, a peripheral device interface 60 that can be connected to peripheral devices (not shown), a wired network interface 30 that can be connected to a wired network 40, a wireless network interface 70 that can be connected to a wireless network 80, and protocol modules that can communicate with the wired network interface 30 and the wireless network interface 70, respectively. All of these communicate across a bus 90.

[0003] To implement networking in a local area network (LAN) using the system of Figure 1, a network interface card (NIC) is required. The NIC includes a physical device (PHY) that is connected to an actual physical media and can perform transmission/reception of a signal. A media access control (MAC) module is provided that performs MAC with respect to a medium using the PHY. The MAC module operates uses a physical address to communicate with another device in a network. A physical address allocated to the NIC is stored in a ROM such as an electrically erasable programmable ROM (EEPROM) or a non -volatile RAM (NVRAM) in a system.

[0004] Referring to Figure 2, a LAN driver 250 performing packet transmission/reception through a network is present in an upper layer above the NIC 260. The LAN driver 250 is connected to a protocol module in an upper protocol layer 230, which performs packet flow control and packet transfer, via a network driver interface 240. As shown, the NIC 260 includes a wired MAC 262 with associated PHY 264 and a wireless MAC 266 with associated PHY 268. In the example shown, the protocol layer 230 includes TCP/IP and IPX/SPX protocols. A connection is made secure by using socket layer 220 for protocols 210 such as HTTP, FTP, and POP 3.

[0005] The NIC 260 has a 48-bit fixed physical address, and the protocol module in layer 230 uses a logical address such as an Internet Protocol (IP) address to designate an addres s. The physical address and the logical address allow the system to be identified in the network. The physical address is stored in an area such as ROM 120 in the system. This is determined during manufacture and is transmitted to the MAC module 262, 266 during system initiali sation.

[0006] Referring to Figure 3, a destination physical address 310 in the Ethernet frame of Figure 3 indicates a MAC address of a host that is to receive data 340. A source physical address 320 indicates a MAC address of a host tra nsmitting the data 340.

Each of the destination and source physical addresses are 48 bits long. Also, if a first bit is 0, the data 340 is unicast (i.e., transmitted to only one receiving host in the network). If the first bit is 1, the data 340 is multicast (i.e., transmitted to only a number of hosts in the network). If all of the 48 bits are 1, the data 340 is broadcast to all of hosts in the network. Also included are a frame type 330 and a frame check sequence (FCS) 350.

[0007] Before the data is transm itted through the network, an address used in a current layer is embedded into a header of a packet. A receiving party analyses the address embedded in the header and determines whether the data has been received correctly. If the address embedded in the header is not identical with the receiving party 's address, the receiving party will not receive the packet or discard s the received packet without processing it.

[0008] In a system connected to a network, a packet received via an NIC 260 is transmitted to an application program via an upper protocol module 230 bound with the NIC 260.

[0009] Data generated in the application program is transmitted to the network via the protocol module 230 and the NIC 260.

[0010] The wireless network interface may be set to operate in an infrastructure mode or an ad-hoc mode. In the ad-hoc mode, a host communicate s with another host in a network in a wireless manner . This communication is done directly between the hosts. In the infrastructure mode on the other hand, a host can communicate with another host in the network via an access point (AP).

[0011] Operations in the ad -hoc mode and in the infrastructure mode will be described with reference to FIGS. 4A and 4B below. Figure 4A illustrates a network in the infrastructure mode. The network includes communication systems 400, 402, 404, 408, and 409 and an AP 406 as shown in Figure 1.

[0012] Among the communication systems 400, 402, 404, 408, and 409 shown in Figure 4A, one is a hybrid wire and wireless communication system, and the others are various types of communication systems that can communicate either by wire and/or in a wireless manner with the hybrid wire and wireless communication system of Figure 1. For example, where the communication system 408 is the hybrid wire and wireless communicatlon system, when the hybrid wire and wireless communication system 408 communicates in a wireless manner with the communication system 402, the hybrid wire and wireless communication system 408 communicates with the communication system 402 via the AP 406. Alternatively, if the communication system 400 is the hybrid wire and wireless communication system of Figure 1, the hybrid wire and wireless communication system 400 communicates by wire with the communication systems 402 and 404, and communicates with communication systems 408 and 409 via the AP

406 in a wireless manner.

[0013] As described above in Figure 4A, a wireless communication mode in which the hybrid wire and wireless communication system communicates with other types of communication systems in a wireless manner not directly but via the AP 406 or the like is referred to as the infrastructure mode.

[0014] Figure 4B illustrates a network in the ad-hoc mode. The network includes communication systems 410, 412, and 414. Among the communication systems 410, 412, and 414 shown in Figure 4B, one is the hybrid wire and wireless communication system of Figure 1, and the others are other types of communication systems that can communicate using a wire or in a wireless manner with the hybrid wire and wireless communication system. For example, when a hybrid wire and wireless communication system 410 communicates with the other communication systems 412 and 414 in a wireless manner, the hybrid wire and wireless communication system 410 communicates, in a wireless manner, with the other communication systems 412 and 414 directly and not via the AP 406 shown in Figure 4A or the like. As described above, a wireless communication mode in which a hybrid wire and wireless communication system communicates with another communication system directly and in a wireless manner, without requiring a relay such as the AP 406 is referred to as the ad-hoc mode.

[0015] As described above, the hybrid wire and wireless communication system can be simultaneously connected to a wired network 140 and a wireless network by using individual wire and wireless network interfaces 130, 170 as shown in Figure 1 . Here, each network interface 260 shown in Figure 2 needs a physical address identifying the network interface in a network. In other words, t he hybrid wire and wireless communication system shown in FIGS. 1 and 2 has two or more MAC modules 262, 266, and two or more physical addresses allocated to the two or more MAC modules 262, 266, respectively. This is because one address will be used in t he wired network and the other address will be used in the wireless network.

[0016] To overcome this disadvantage, a hybrid wired and wireless communication system using a single physical address has been introduced. Such hybrid wired and wireless communication system includes individual MAC modules , although only one physical address is stored in the associated memory. Further, the system allocates the same physical address to the individual MAC modules. In such a structure, since the individual MAC modules u se the same physical address, they are recognized as the same unit by other devices on a network. Accordingly, when the hybrid wire and wireless communication system (both of which use a single physical address) is connected to a wired network, and the wireless network interface is operating in the infrastructure mode, a double link is made. Therefore, packet transmission/reception through the wireless network interface is interrupted.

[0017] However, when the wireless network interface operates in the ad -hoc mode, packet transmission/reception through the wireless network interface can be performed even though the hybrid wire and wireless communication system is connected to the wired network. While usable, when the hybrid wired and wireless communication sy stem is connected to the wired network and its wireless network interface operates in the ad-hoc mode, a protocol module in an upper layer 230 above the NIC 260 cannot determine the network interface through which a packet will be transmitted. As a result, the hybrid wire and wireless communication system transmits data through both of the wired and wireless network interfaces, and a packet is redundantly transmitted through either the wired or wireless networks. Consequently, traffic of one network is loaded onto another network, which causes unnecessary use of bandwidth.

[0018] The present invention relates to a method of controlling data transmission over a hybrid network having a wired and wireless part, comprising receiving data including a source identifier from a source over the hybrid network.

[0019] A method according to the present invention is characterised by storing a network identifier in association with the source identifier, the network identifier identifying whether said data was received over the wir ed or wireless part, and transmitting data to said source using either the wired or wireless part in dependence on the stored network identifier.

[0020] The present invention also relates to an apparatus an apparatus for controlling data transmission over a hybrid network having a wired and wireless part, comprising means for receiving data including a source identifier from a source over the hybrid network.

[0021] An apparatus according to the present invention is characterised by means for storing a network identifier in association with the source identifier, the network identifier identifying whether said data was received over the wired or wireless part and means for transmitting data to said source using either the wired or wireless part in dependence on the stor ed network identifier.

[0022] The present invention is advantageous because the data to be transmitted to a device is only transmitted over the network to which the device is connected. This reduces the amount of unnecessary traffic over a network and also ensu res that devices on the network are not inundated with unnecessary data.

[0023] An embodiment of the present invention will now be described, by way of example only, with reference to Figures 5 - 10, In which:

Figure 1 is a block diagram of a known hybrid wired and wireless communication system;

Figure 2 is a block diagram of a known network system;

Figure 3 illustrates a structure of a known Ethernet

frame;

Figure 4A illustrates a network in a known infrastructure mode;

Figure 4B illustrates a network in a known ad-hoc mode;

Figure 5 is a block diagram of a hybrid wired and wireless communication system according to an embodiment of the present invention;

Figure 6 illustrates a structure of a management list according to an embodiment of the present invention;

Figure 7 is a flowchart of a system initiali sation procedure according to an embodiment of the present invention;

Figure 8 is a flowchart of a communication method when a wireless communication mode is the ad-hoc mode, according to an embodiment of the pres ent invention;

Figure 9 is a detailed flowchart of an operation of generating a management list and registering a physical address shown in Figure 8; and

Figure 10 is a flowchart of an operation of managing an entry in a management list that is performed by a storage unit shown in Figure 5 according to an embodiment of the present invention.

[0024] Referring to Figure 5, a hybrid wired and wireless communication system includes a wired network interface 510 connected to a wired network 500, a wireless network interface 530 connected to a wireless network 520, a management module 540, a storage unit 550, and a control module 560. The management module 540 receives packets through the wired network interface 510 and the wireless network interface 530, registers a physical address of the source of the received packet in a management list, and transmits the received packet to an upper layer. The storage unit 550 stores and updates the management list which includes a plurality of management entries. Each of the entries includes a physical address of the source of the received packet and an interface number indicating which of the wired network interface 510 or the wireless network interface 530 is linked to the physical address.

[0025] The control module 560 receives a t ransmission packet from an upper layer, checks whether the physical address of a source for the transmission packet is present in the management list stored in the storage unit 560, and selectively transmits the transmission packet through the wired or wir eless network interface 510 or 530 according to the interface number linked to the physical address in the management list. Thls occurs when the physical address is present in the management list. The management module 540 and the control module 560 are implemented on a known local area network (LAN) driver as shown in Figure 2, which is understood by those skilled in the art. While not shown in Figure 5, it is understood that the CPU 100, ROM 120, Interface 160, RAM 150, and/or BUS 190 of Figure 1 will be included in the system shown in Figure 5 according to the present invention. However, it is understood that the system can be otherwise configured and/or used with the network types other than LAN, such as wide area networks (WAN), public and private n etworks such as the internet and intranets, and/or in any communication medium by which a device connected to the network utilizes identification for transmission and/or reception of data.

[0026] Referring to Figure 6, the management list includes a physical add ress item, an interface number item, and a timer item. The management list shown in Figure 6 further includes an optional type item. This type item indicates whether an entry is valid or invalid according to the timer item . It should be noted that the t ype item is optional to the working of the invention. Further, it is understood that the management list could include additional information, and that items in the management list could be combined to reduce the number of entries according to the inventi on.

[0027] A physical address in the management list indicates the media access control (MAC) address of the source of the received packet included in the packet frame shown in Figure 3. In the shown embodiment of the present invention, the physical address is 48 bits in length. However, it is understood that the physical address can have other lengths and formats.

[0028] An interface number (or interface identifier) in the management list is an identifier indicating which of the the wired network interface 510 or th e wireless network interface 530 that received the packet. In other words, the interface number indicates a network interface linked to the physical address. As shown, the identifier number "2" indicates the wired interface 510, and the identifier number "1" indicates the wireless interface 530.

[0029] To prevent the occurrence of unnecessary traffic and other such problems, whenever a packet is received, the management list records the physical address of the source transmitting the packet and the associated interface number indicating whether a network interface linked to the physical address is wired or wireless. When a transmission packet is generated in the upper layer for transmission to a physical address corresponding to a physical address in the manage ment list, the transmission packet is transmitted through either the wired or wireless network only. The choice of the network is made in accordance with the the interface number linked to the physical address in the management list. Accordingly, the phy sical address item and the interface number item are essential to the management list in the embodiment shown in Figure 6. However, it is understood that, if the physical address and identifier can be otherwise combined or where the identifier of the inte rface 510, 530 can be otherwise correlated or conveyed using a single entry and/or other entry, the management list need not include both the physical address and the identifier in the form shown in Figure 6.

For example, the first bit of the stored physi cal address may indicate whether the wired or wireless network should be used.

[0030] A timer indicates the length of time which has passed from the generation of the entry (i.e. when the physical address is added to the management list) to the removal of the entry from the management list. A type indicates whether an entry is valid and should remain In the management list, or Is invalid and is to be removed from the management list. It is understood that the type can also indicate other information of interest, and that the type need not be used, for example if the system removes the entry as soon as the a specified period of time has elapsed.

[0031] In the described embodiment, to increase storage efficiency of the management list, a length of time is defined. The entry is stored for this time. In detail, the timer item is included in the management list, and an initial value of the timer item is set. Thereafter, a value of the timer item is increased or decreased, and when a predetermined time lapses, an entry ha ving an expiring timer is removed from the management list. Before the time expires, if another packet is received from the same physical address, the timer is initiali sed. When the time expires, the type for that entry is set to invalid indicating that the entry is to be deleted. The system then deletes the entry. Otherwise, the type is set to valid. This means that the type item indicates whether a corresponding entry is to be removed. However, it is understood that the timer and/or type fields are optional and, as such, need not be used is all aspects of the invention, such as where a record of transmission and/or reception is desired.

[0032] Referring to Figure 7, w hen a hybrid wired and wireless communication system is supplied with electric al power and is booted, the system is initialised is in operation S700. In the system initiali sation, a single physical address stored in a memory unit (not shown) is transmitted to the LAN driver. The LAN driver includes the management module 540 and the control mo dule 560. The LAN driver allocates the physical address to each network interface 510, 530 of the hybrid wired and wireless communication system to initiali se a MAC module. The LAN driver then initialises a transmitter and a receiver of each network inte rface 510, 530.

[0033] After the system initiali sation In operation S700, the LAN driver checks the operating mode and state of the wired network interface 510 and the wireless network interface 530. In particular, the LAN driver checks whether the wireless communication mode is the ad-hoc mode (in operation S710). When the wireless communication mode is the ad-hoc mode, the management module 540 and the control module 560 begin operation S720, S730. When the wireless communication mode is not the ad -hoc mode, operations S720 and S730 are not performed.

[0034] Referring to Figure 8, the management module 540 generates the management list shown in Figure 6 using a received packet and registers a source physical address included in the received packet in the managemen t list in operation S800. An embodiment of operation S800 will be described in detail with further reference to Figure 9 below.

[0035] When a hybrid wired and wireless communication system is started and the management module 540 is started in the ad -hoc mode, the storage unit 550 initiali ses the management list in operation S900. Thereafter, a packet receiver 542 included in the management module 540 determines whether a packet has been received from a wired receiver 512 included in the wired network interface 510 or a wireless receiver 532 included in the wireless network interface 530 in operation S910. If it is determined that a packet has been received, an address checker 544 included in the management module 540 checks the source physical address included in the received packet to determine whether the source physical address indicates a unicast transmission. This is performed in operation S915.

[0036] If the source physical address indicates broadcast or multicast transmission, the address checker 544 just transmits the received packet to an upper layer in operation S950 without performing operations S930 or S920. If the source physical address indicates unicast transmission, the address checker 544 determines, with reference to the storage unit 550, whether the source physical address, (i.e., the source MAC address) is present in the management list. This is performed in operation S920. It is understood, however, that operation S915 is optional and thus, need not be performed. If operation S915 Is not perfo rmed, operation 920 is performed regardless of whether the packet is unicast, broadcast, and /or multicast. Also operation S915 may be performed only for selected packets which are unicast, multicast, and/or broadcast.

[0037] If the source physical address is n ot present in the management list, the management module 540 registers the source physical address and the interface number which indicates a network interface to be linked to the source physical address in the management list. This information is stored in the storage unit 550 in operation S930. By way of example, in the management list shown in Figure 6 , when the wireless network interface 530 is linked to the source physical address, the interface number is set to "1", and when the wired network interface 510 is linked to the source physical address, the interface number is set to "2". In addition, the management module 540 sets a timer to an initial value in operation S930 and transmits the received packet to the upper layer in operation S950.

[0038] Meanwhile, If the source physical address is present in the management list, the storage unit 550 resets to the initial value a timer corresponding to the source physical address in operation S940 and the management module 540 transmits the received packet to th e upper layer in operation S950.

[0039] Referring back to Figure 8, after the manage-

ment list is generated, the control module 560 is started and the packet transmitter 562 included in the control module 560 determines whether the packet to be transmitted over one of the networks has been received from the upper layer in operation S810. If the packet transmitter 562 has received the transmission packet from the upper layer, the list checker 564 included in the control module 560 checks the transmission packet t ō determine whether the destination physical address included in the transmission packet indicates unicast transmission, multicast transmission, or broadcast transmission. This is performed in operation S830. However, it is understood that operation S830 is optional and, as such, need not be performed in all aspects of the invention.

[0040] If it is indicated that multicast or broadcast transmission of the transmission packet should be made, the packet transmitter transmits the transmission packet to both of th e wired transmitter 514 and the wireless transmitter 534 so that the transmission packet is transmitted over both of the wired network 500 and the wireless network 520 . This is performed in operation S860. If it is indicated that unicast transmission of the transmission packet should be made , the list checker 564 determines whether the destination physical address of the transmission packet is present in the management list in operation S840. The list checker 564 achieves this by referring to the storage unit 550 If the destination physical address of the transmission packet is present in the management list, the packet transmitter 562 transmits the transmission packet to the destination address through either the wired network interface 510 or the wire less network interface 530 depending on the interface number which corresponds to the destination physical address stored in the management list. This is performed in operation S850. In detail, when the interface number indicates the wired network interface 510, the packet transmitter 562 transmits the transmission packet to the wired transmitter 514 without transmitting through the wireless transmitter 534 . When the interface number indicates the wireless network interface 530, the packet transmitter 562 transmits the transmission packet to the wireless transmitter 534 without transmitting through the wired transmitter 514 .

[0041] However, if the destination physical address of the transmission packet is not present in the management list, the packet transmitt er 562 transmits the transmission packet to both of the wired transmitter 514 and the wireless transmitter 534 so that the transmission packet is transmitted over both the wired and wireless networks 500 and 520. This is performed in operation S860. However, it is understood that, instead of transmitting through both transmitters 514, 534, the transmission could be through a default one of the transmitters 514, 534 or through one of the transmitters 514, 534 having the least traffic.

[0042] Referring to Figure 10, the storage unit 550 stores the management list. The storage unit 550 periodically checks the timer item in the management list in operation S1000 , and determines whether a valid entry is present in the management list in operation S1010.

[0043] The storage unit 550 determines whether any valid entry has an expir ed timer in operation S1020. If any valid entry has an expired timer, the storage unit 550 changes the valid entry into an invalid state to indicate an entry which may be removed from the management list in operation 1030. If there is no entry having an expir ed timer, all timers are increased or decreased in operation S1040. For example, when an initial value of a timer is 20 and a value of 0 denotes expiration of the timer, the timer is decreased by 1. Conversely, when the initial value of the timer is 0 and the value 20 denotes the expiration, the timer is increased by 1. While not shown in Figure 10, where the timer has expired, the storage unit 550 removes the entry having the expired timer. Additionally, the timer entry can be increased by 1 or reset when a packet is received from the physical address so as to prevent the premature removal of an entry from the management list where the physical address relates to another system which is communicating data packets.

[0044] An aspect of the invention can also be embodied as computer readable codes on a computer readable recording medium or media for use with one or more computers. The computer readable recording medium is any data storage device that can store data which can be thereafter read by a computer system. Examples of the computer readable recording medium include read -only memory (ROM), random -access memory (RAM), CD-ROMs, magnetic tapes, floppy disks, optical data storage devices, and carrier waves (such as data transmission through the Internet). The computer readable recording medium can also be distributed over network coupled computer systems so that the computer readable code is stored and executed in a distributed fashion.

[0045] It is understood that, according to an aspect of the invention, the management list can be otherwise updated and can be created by other devices without requiring reception of a packet from a source. Moreover, while shown as having two interfaces 510, 530, it is understood that the management list of an aspect of the present invention can be used with a plurality of interfaces for use in systems having multiple network connections and sharing a common address.

[0046] A hybrid wired and wireless communication system acco rding to the present invention uses a single physical address for both of wired and wireless network interfaces, and whenever a packet is received, records a physical address of a source transmitting the packet and an interface number indicating whether a network interface linked to the physical address is wired or wireless in a management list. Thereafter, when a transmission packet generated in an upper layer is transmitted to the physical address in the management list, the hybrid wired and wireless com munication system selec-

tively transmits the transmission packet through either of the wired network interface and the wireless network interface according to the interface number linked to the physical address in the management list. Therefore, an aspect of the present invention prevents traffic of one network from being loaded onto another network, thereby preventing dissipation of a bandwidth.

Claims

1. A method of controlling data transmission over a hybrid network having a wired and wireless part, c omprising:

   receiving data including a source identifier from a source over the hybrid network, **characterised by**:

   storing a network identifier in association with the source identifier, the network identifier identifying whether said data was received ove r the wired or wireless part; and transmitting data to said source using either the wired or wireless part in dependence on the stored network identifier.

2. A method according to claim 1, comprising:

   associating timing information with the source ident ifier; and
   deleting the source identifier when the timing information reaches a predefined limit.

3. A signal representing program codes for controlling a computer, having a wireless networking capability, to perform a method according to either one of c laims 1 or 2.

4. A data carrier having a signal according to claim 3 recorded thereon or therein.

5. An apparatus for controlling data transmission over a hybrid network having a wired and wireless part (500, 520), comprising:

   means (542) for receiving data including a source identifier from a source over the hybrid network, **characterised by**:

   means (540) for storing a network identifier in association with the source identifier, the network identifier identifying whether said data was received over the wired or wireless part; and
   means (560) transmitting data to said source using either the wired or wireless part in dependence on the stored network identifier.

6. An apparatus according to claim 5, comprising:

   means (550) for storing timing information in association with the source identifier; and
   means (540) for deleting the source identifier when the timing information reaches a predefined limit.

7. A network interface card comprising:

   a first adapter connectable to the wired part of the hybrid ne twork;
   a second adapter connectable to the wireless part of the hybrid; and
   an apparatus according to either one of claim 5 or 6.

8. A computer containing a network interface card according to claim 7.

9. A communication method for a hybrid wired and wireless communication system capable of communicating by wire and wirelessly in a local area network, the communication method comprising:

   registering an entry comprising a source physical address of a source transmitting a received packet and an identifie r indicating and distinguishing between a wired network interface and a wireless network interface linked to the physical address in a predetermined management list;
   receiving a transmission packet from an upper layer of the system and determining whether a registered physical address that is identical with a destination physical address of the received transmission packet is present in the management list; and
   when the destination physical address is present in the management list, selectively transmitting the transmission packet through the indicated one of the wired network interface and the wireless network interface according to the identifier.

10. The communication method of claim 9, wherein the entry further comprises :

    a timer indicating a duration from a generation of the entry in the management list to a removal of the entry from the management list.

11. The communication method of claim 10, wherein the registering of the entry comprises:

    periodically checking a value of the timer to de-

termine the duration until the timer expires; and removing the entry from the management list if the timer expires.

12. The communication method of claim 9, wherein the registering of the entry comprises:

determining whether the source physical address of the recei ved packet is present in the management list;
when the source physical address is not present in the management list, registering the source physical address and the identifier in the management list;
transmitting the received packet to the upper layer; an d
determining whether a new packet has been received through either of the wired network interface and the wireless network interface and repeating the determining of whether the source physical address is present, the registering of the source physical address and the identifier, and the transmitting of the received new packet to the upper layer.

13. The communication method of claim 12, wherein the entry further comprises :

a timer indicating a duration from a generation of the entry in the management list to a removal of the entry from the management list, and

wherein the determining whether the source physical address is present further comprises resetting the timer to a predetermined initial value when the source physical address of the received packet is determined to be present in the management list at the time the received packet is received.

14. The communication method of claim 9, wherein the operation of receiving the transmission packet and determining whether the physical address is identical with the destination physical address of the transmission packet is present comprises:

receiving the transmission packet from the upper layer and determining whether a type of the destination physical address indicates a unicast transmission;
transmitting the transmission packet through the wired network interface and the wireless network interface , when the type of the destination physical address is determined not to indicate the unicast transmission ; and
determining whether the physical address is identical with the destination physical address of the transmission packet is present in the management list , when the type of the destination physical address is determined to indicate the unicast transmission.

15. The communication method of claim 9, wherein the transmitting of the transmission packet comprises transmitting the transmission packet through the wired network interface and the wireless network interface when the destination physical address is not present in the management list.

16. The communication method of claim 9, wherein the registering of the entry, the operation of receiving the transmission packet and determining whether the physical address is identical with the destination physical address of the transmission packet is present, and the selectively transmitting the transmission packet through of the indicated one of the wired network interface and the wireless network interface according to the identifier are performed when a wireless communication mode of the hybrid wired and wireles s communication system is an ad -hoc mode.

17. The communication method of claim 9, wherein the wireless network interface and the wired network interface have a same physical address.

18. A computer readable recording medium for storing a program code fo r executing in a computer a communication method for a hybrid wired and wireless communication system capable of communicating by wire and wirelessly in a local area network, the communication method comprising:

registering an entry comprising a source physical address of a source transmitting a received packet and an identifier indicating and distinguishing between a wired network interface and wireless network interface linked to the physical address in a predetermined management list;
receiving a transmission packet from an upper layer of the system and determining whether a registered physical address that is identical with a destination physical address of the transmission packet is present in the management list; and
when the destination physical addre ss is present in the management list, selectively transmitting the transmission packet through of the indicated one of the wired network interface and the wireless network interface according to the identifier.

19. A hybrid wired and wireless communicatio n system capable of communicating by wire and wirelessly in a local area network, the hybrid wired and wireless communication system comprising:

an upper layer;
a processor which receives and transmits packets received through the upper layer;
a storage unit which stores a management list comprising a plurality of entries , each of the entries comprising a physical address of a source transmitting a received packet and an identifier indicating and distinguishing between a wired network interface and a wireless network interface linked to the physical address;
a management module which determines whether a physical address that is identical with a source physical address included in a received packet is present in one of the entries the management list, registers the source physical address and an identifier corresponding to the physical address in a new entry of the management list when the physical address is determined to not be present in the management list, and transmitting the received packet to upper 1 ayer;
a control module receiving a transmission packet from the upper layer and selectively transmitting the transmission packet through an indicated one of the wired network interface and the wireless network interface according to an identifier corresponding to a destination physical address of the transmission packet when the destination physical address is present in the management list;
a wired network interface which transmits the received packet to the management module, and, if the control module c ontrols the received packet to be transmitted through the wired network interface, receives the transmission packet from the control module and transmits the transmission packet to the wired network connected thereto; and
a wireless network interface which transmits the received packet to the management module, and, if the control module controls the received packet to be transmitted through the wireless network interface, receives the transmission packet from the control module and transmit s the transmission packet to the wireless network connected thereto.

20. The hybrid wired and wireless communication system of claim 19, wherein each entry further comprises a timer indicating a duration from a generation of the entry to a removal of the entry in the man agement list.

21. The hybrid wired and wireless communication system of claim 20, wherein the storage unit periodically checks a value of the timer of each entry to determine whether the timer has expired and, if the duration indicates that the entry has expired, removes the entry having expiring timer from the management list.

22. The hybrid wired and wireless communication system of claim 20, wherein, when the source physical address is determined to be present in the management list when the received p acked is received, the storage unit resets the timer of the entry corresponding to the source physical address to a predetermined initial value.

23. The hybrid wired and wireless communication system of claim 19, wherein the control module further checks a type of the destination physical address of the transmission packet received from the upper layer, transmits the transmission packet through both of the wired network interface and the wireless network interface when the type of the destination physical address does not indicate a unicast transmission, and determines whether the physical address that is identical with the destination physical address is present in the management list when the type of the destination physical address indicates the unicast transmission.

24. The hybrid wired and wireless communication system of claim 19, wherein the control module transmits the transmission packet through the wired network interface and the wireless network interface when the destination physical address is not registered in one of the entries in the management list.

25. The hybrid wired and wireless communication system of claim 19, wherein the wireless network interface and the wired network interface have a same physical address.

26. The hybrid wired and wireless communication system of claim 19 , wherein the hybrid wired and wireless communication system operates when a wireless communication mode is an ad -hoc mode.

27. A communication method for a hybrid communication system capable of communicating by a first network of a first type and by a second network of a second type other than the first type, the communication method comprising:

for a transmission packet to be transmitted from the system to one of the first and second networks, determining whic h one of first and second interfaces is to be used to transmit the received transmission packet based on a comparison of a destination physical address of the transmission packet with a management list of the system; and
selectively transmitting the trans mission packet through the determined one of the first and

second interfaces while not transmitting the transmission packet through the other one of the first and second interfaces.

28. The communication method of claim 27, wherein the first type of netwo rk is a wired network, and the second type of network is a wireless network.

29. The communication method of claim 27, further comprising:

receiving at the system another packet from the destination physical address, and
recording in the management list through which one of the first and second interfaces the another packet was received and the destination physical address.

30. The communication method of claim 29, wherein the determining which one of first and second interfaces is to be used to transmi t the transmission packet comprises:

reviewing the destination physical address detected from the transmission packet and the management list to detect an entry of the management list that indicates through which one of the first and second interfaces the another packet was received from the destination physical address, and
determining that the one of the first and second interfaces recorded in the detected entry is the one of the first and second interfaces through which the transmission packet is to be transmitted.

31. The communication method of claim 27, wherein:

the management list comprises first and second entries,
the first entry comprises a first physical address and an indication that the first interface is to be used in transmitting to the fi rst physical address,
the second entry comprises a second physical address and an indication that the second interface is to be used in transmitting to the second physical address, and
the determining which one of first and second interfaces is to be used to transmit the received transmission packet comprises:

determining that the first interface is to be used if the destination physical address corresponds to the first physical address, and
determining that the second interface is to be used if the dest ination physical address corresponds to the second physical address.

32. The communication method of claim 27, wherein:

the management list comprises a first entry comprising a first physical address, an indication indicating and distinguishing between w hich one of the first and second interfaces is to be used in transmitting to the first physical address, and a validity indication, and

the communication method further comprises deleting the first entry if the validity indication indicates that the first entry is not valid.

33. The communication method of claim 32, wherein the validity indication comprises a timer value which is decremented such that the system deletes the first entry a predetermined time after a time when the first entry was created.

34. The communication method of claim 33, further comprising, if another packet is received from a same physical address as the first physical address, increasing the timer value.

35. The communication method of claim 27, wherein the first and second interf aces share a common physical address such that a first packet received at the first interface through the first network is addressed to the common physical address and a second packet received at the second interface through the second network is addressed to the common physical address.

36. A computer readable medium encoded with processing instructions for implementing the communication method of claim 27 performed by a computer.

37. A communication system capable of communicating packets of data acros s a first network of a first type of and a second network of a second type other than the first type, the communication system comprising:

a first network interface which connects to the first network to transfer ones of the packets with respect to the fir st network;
a second network interface which connects to the second network to transfer others of the packets with respect to the second network;
a storage unit which stores a management list comprising a plurality of entries , each of the entries identifying and distinguishing between the first and second network interfaces; and
a processor which compares a transmission

packet to be transmitted and the entries of the management list, determines based on the comparison which one of the first and second netwo rk interfaces is to be used for transmission of the transmission packet, and controls the transmission packet to be transmitted through the determined one of the first and second network interfaces.

38. The communication system of claim 37, wherein:

the transmission packet includes a destination physical address,
each of the entries includes a corresponding physical address and identifies and distinguishes between the first and second network interfaces, and
the processor further determines whether one of the entries includes the physical address that is identical with the destination physical address included in the transmission packet, and controls the transmission packet to be transmitted through the indicated one of the first and second network interf aces included in the one entry having the identical physical address as the destination physical address.

39. The communication system of claim 37, wherein the processor further, for a received packet having a source physical address, if the source physic al address is a physical address not present in one of the entries the management list, records a new entry in the management list including the source physical address and an identifier indicating through which one of the first and second network interfac es the received packet was received.

40. The communication system of claim 37, wherein the first type of network is a wired network, and the second type of network is a wireless network.

41. The communication system of claim 37, wherein:

one of the en tries further comprises a validity indication, and
the processor further deletes the one entry if the validity indication indicates that the one entry is not valid.

42. The communication system of claim 41, wherein the validity indication comprises a time value, and the processor decrements the timer value such that the system deletes the one entry at a predetermined time after a time when the one entry was created.

43. The communication system of claim 41, wherein:

the one entry further includes a physi cal address and identifies and distinguishes between the first and second network interfaces, and
the processor further adjusts the validity indication according to when the physical address in the one entry was last verified.

44. The communication system of claim 43, wherein:

if another packet is received and includes a physical address identical to the physical address indicated in the one entry, the processor verifies the validity indication to prevent deletion for an additional period of time.

45. The communication system of claim 44, wherein:

the validity indication comprises a timer value, and
the processor decrements the timer value such that the system deletes the first entry at a predetermined time after a time when the one entry was created, an d increments the time value if the validity indication is verified.

46. The communication system of claim 37, wherein the first and second interfaces share a common physical address such that a first packet received at the first network interface through the first network is addressed to the common physical address and a second packet received at the second network interface through the second network is addressed to the common physical address.

47. A communication system capable of communicating packets of data across a first network of a first type of and a second network of a second type other than the first type, the communication system comprising:

a first network interface which connects to the first network to transfer ones of the packets with respe ct to the first network;
a second network interface which connects to the second network to transfer others of the packets with respect to the second network;
a storage unit which stores a management list comprising a plurality of entries , each of the entries identifying and distinguishing between the first and second network interfaces; and
a processor which compares a received packet received through one of the first and second network interfaces and the entries of the management list, and, if the received packet is from a source physical address not included in the entries of the management list, records a new entry including the source physical address and an indication which indicates which one of the first and second network interfaces received

the rec eived packet.

48. The communication system of claim 47, wherein the processor further controls a transmission packet to be transmitted through the first and second network interfaces according to the indication in the management list.

49. The communication system of claim 47, wherein:

one of the entries further comprises a validity indication, and
the processor further deletes the one entry if the validity indication indicates that the one entry is not valid.

50. The communication system of claim 49, wherein the validity indication comprises a timer value, and the processor decrements the timer value such that the system deletes the one entry at a predetermined time after a time when the one entry was created.

51. The communication system of claim 49, wherein:

the one entry further includes a physical address and identifies and distinguishes between the first and second network interfaces, and
the processor further adjusts the validity indication according to when the physical address in the one entry wa s last verified.

52. The communication system of claim 51, wherein:

if another packet is received and includes a physical address identical to the physical address indicated in the one entry, the processor verifies the validity indication to prevent deletion for an additional period of time.

53. The communication system of claim 52, wherein:

the validity indication comprises a timer value, and
the processor decrements the timer value such that the system deletes the first entry at a predetermined time a fter a time when the one entry was created, and increments the time value if the validity indication is verified.

54. The communication system of claim 47, wherein the first and second interfaces share a common physical address such that a first packet re ceived at the first network interface through the first network is addressed to the common physical address and a second packet received at the second network interface through the second network is addressed to the common physical address.

FIG. 1 (RELATED ART)

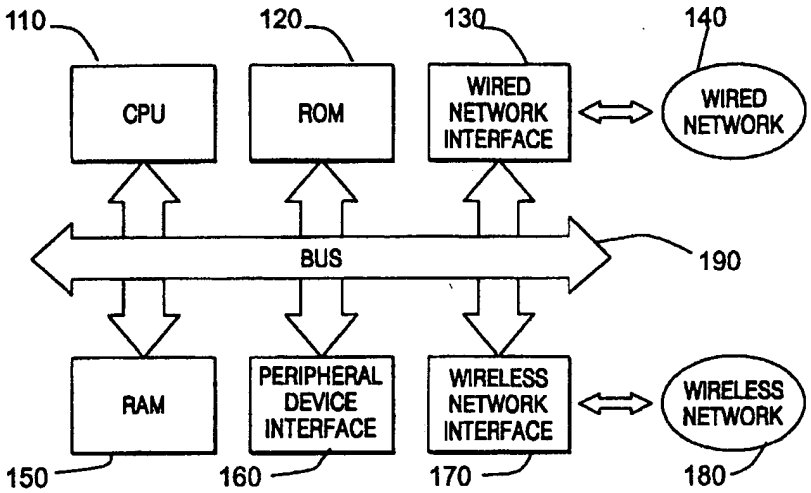


FIG. 2 (RELATED ART)

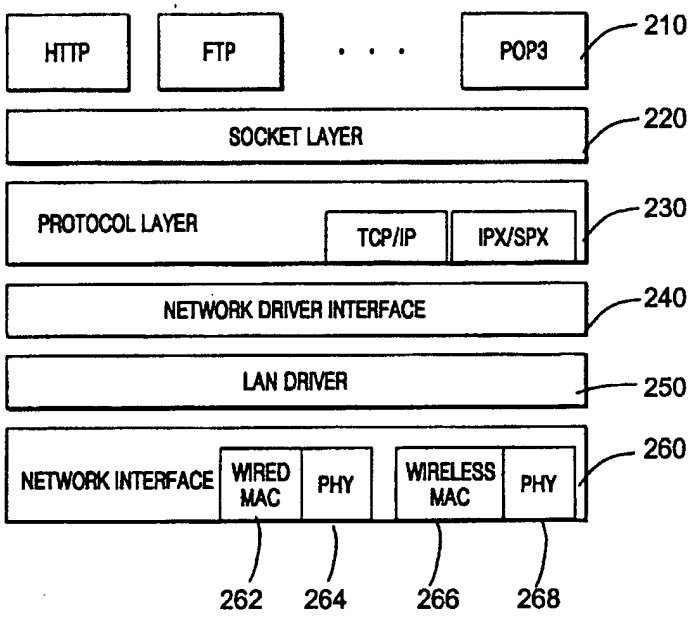


FIG. 3 (RELATED ART)

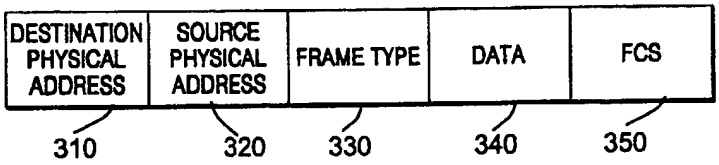


FIG. 4A (RELATED ART)

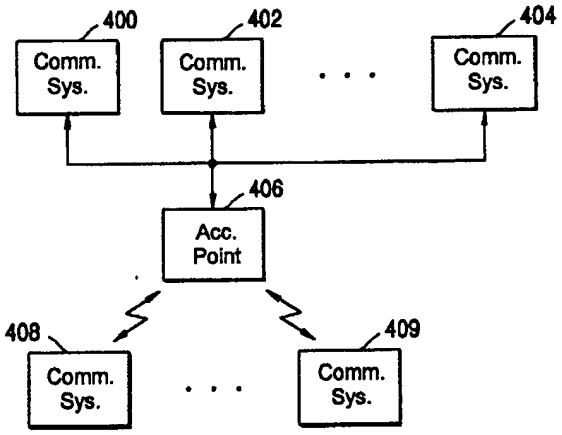


FIG. 4B (RELATED ART)

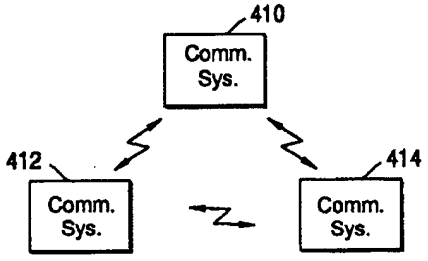


FIG. 5

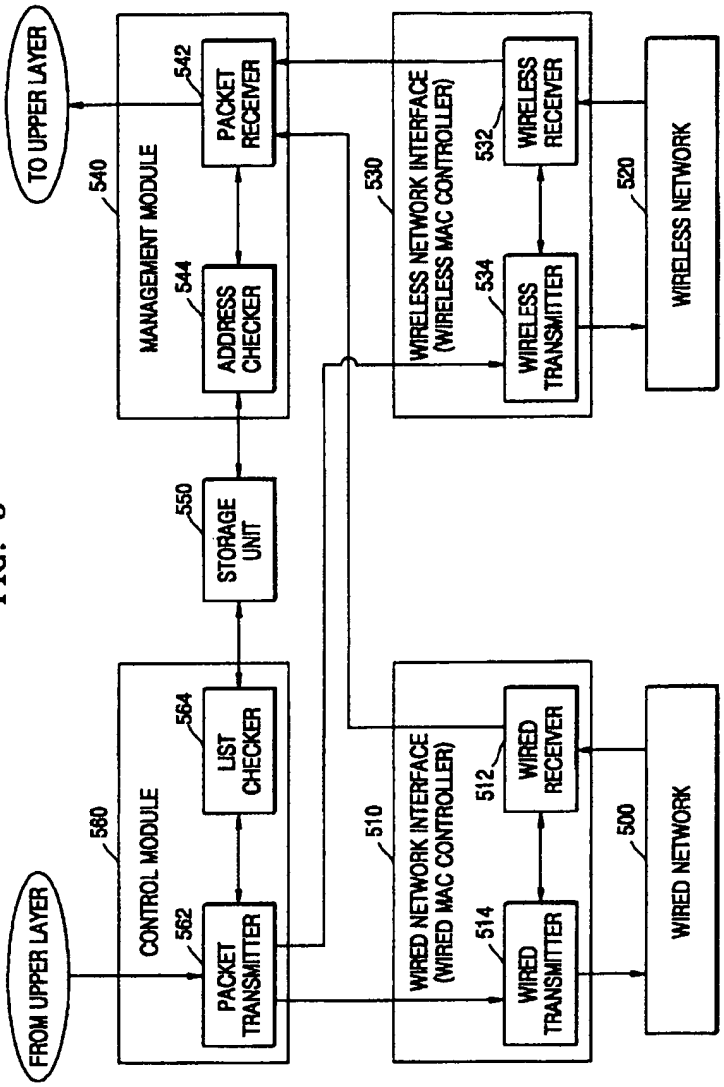

TO UPPER LAYER
FROM UPPER LAYER
MANAGEMENT MODULE
540
PACKET RECEIVER
542
ADDRESS CHECKER
544
CONTROL MODULE
560
PACKET TRANSMITTER
562
LIST CHECKER
564
STORAGE UNIT
550
WIRELESS NETWORK INTERFACE (WIRELESS MAC CONTROLLER)
530
WIRELESS RECEIVER
532
WIRELESS TRANSMITTER
534
WIRELESS NETWORK
520
WIRED NETWORK INTERFACE (WIRED MAC CONTROLLER)
510
WIRED RECEIVER
512
WIRED TRANSMITTER
514
WIRED NETWORK
500

FIG. 6

ENTRY NUMBER	PHYSICAL ADDRESS	INTERFACE IDENTIFIER	TIMER	TYPE
1	xx-xx-xx-xx-xx-xx	2	15	VALID
2	xx-xx-xx-xx-xx-xx	2	10	VALID
3	xx-xx-xx-xx-xx-xx	1	0	INVALID
4	xx-xx-xx-xx-xx-xx	2	0	INVALID

FIG. 7

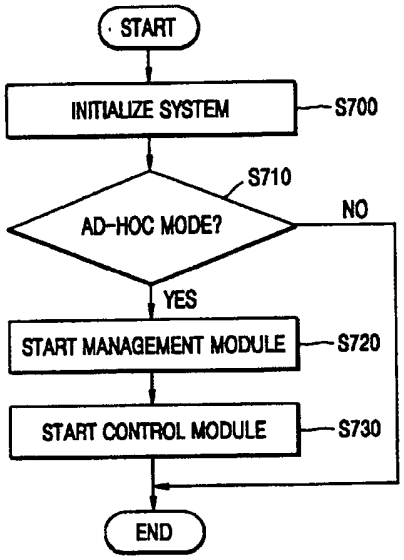


FIG. 8

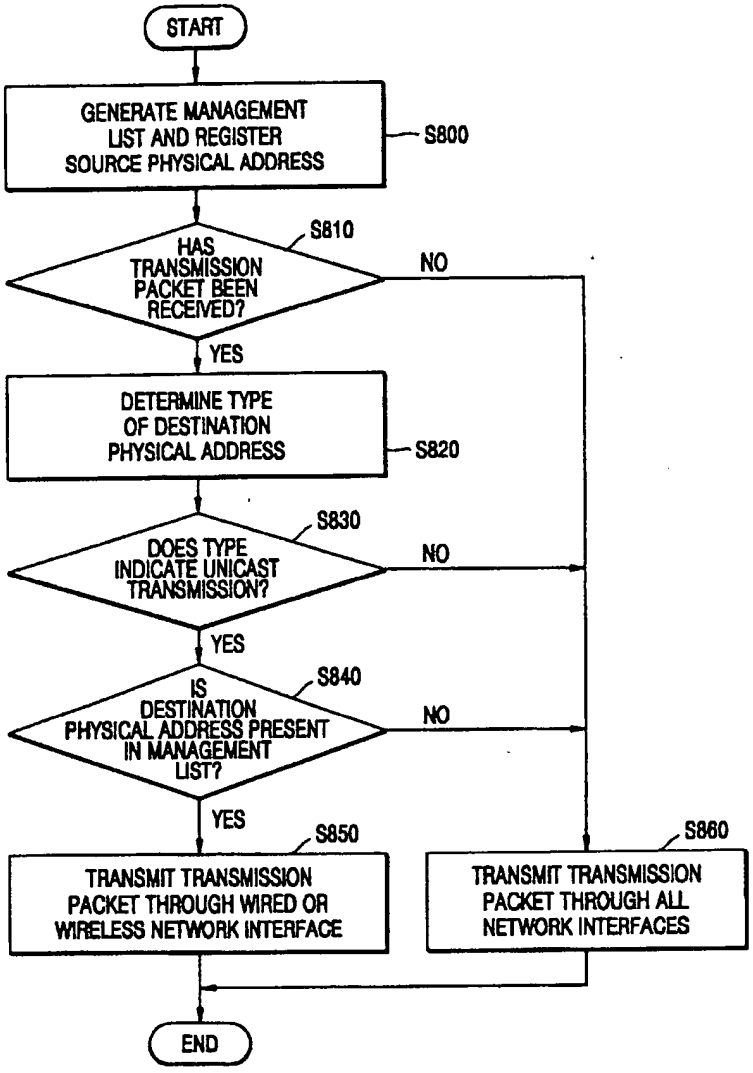

START
GENERATE MANAGEMENT LIST AND REGISTER SOURCE PHYSICAL ADDRESS
S800
HAS TRANSMISSION PACKET BEEN RECEIVED?
S810
NO
YES
DETERMINE TYPE OF DESTINATION PHYSICAL ADDRESS
S820
DOES TYPE INDICATE UNICAST TRANSMISSION?
S830
NO
YES
IS DESTINATION PHYSICAL ADDRESS PRESENT IN MANAGEMENT LIST?
S840
NO
YES
TRANSMIT TRANSMISSION PACKET THROUGH WIRED OR WIRELESS NETWORK INTERFACE
S850
TRANSMIT TRANSMISSION PACKET THROUGH ALL NETWORK INTERFACES
S860
END

FIG. 9

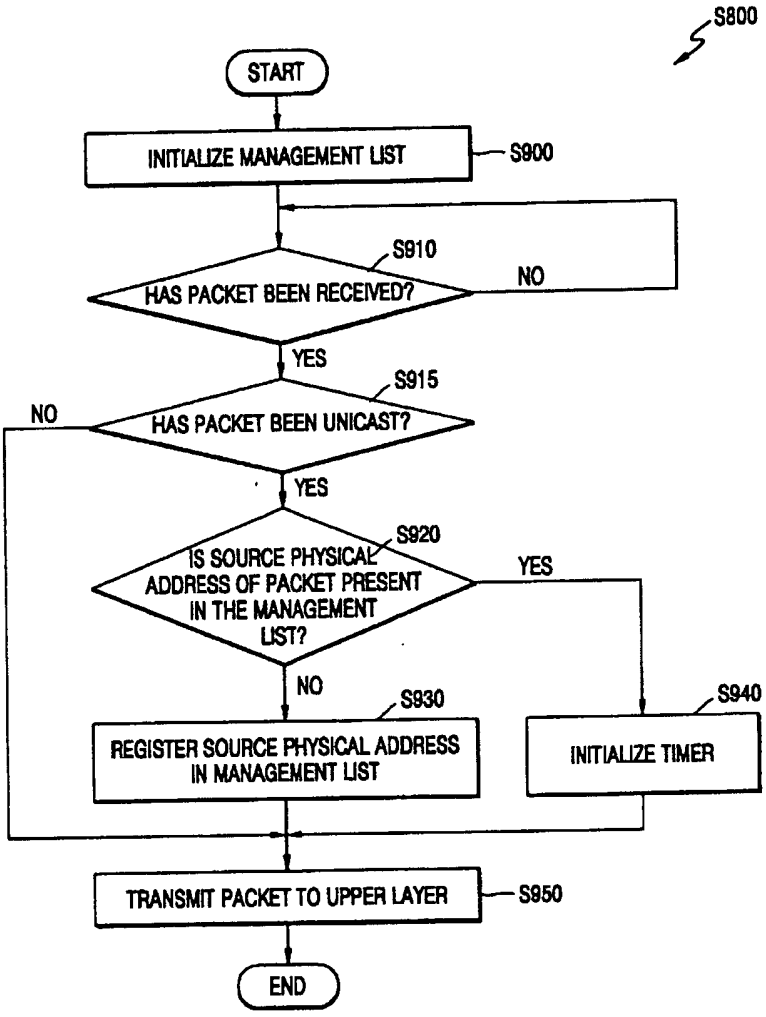
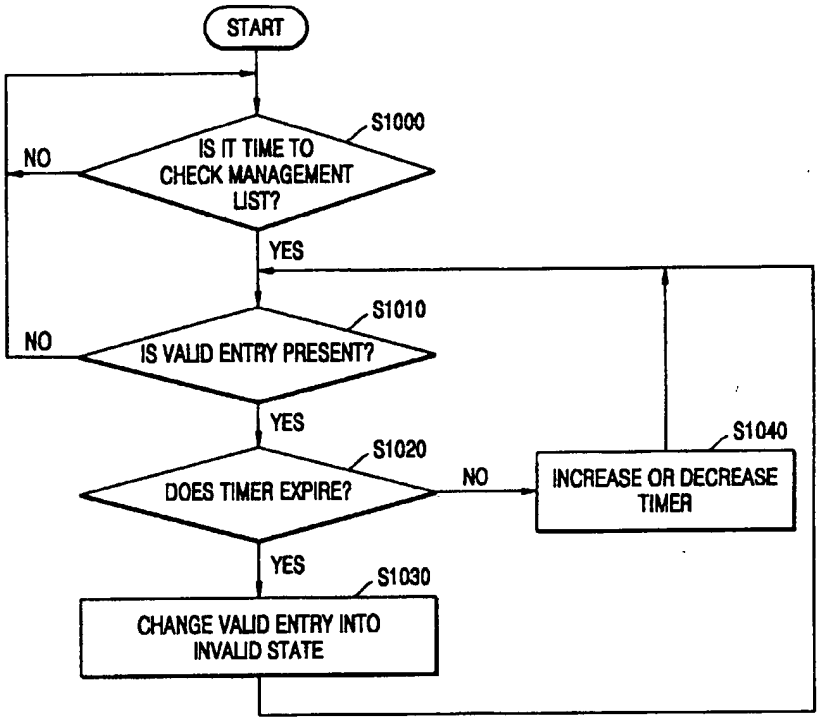

S800
START
INITIALIZE MANAGEMENT LIST
S900
S910
HAS PACKET BEEN RECEIVED?
NO
YES
S915
HAS PACKET BEEN UNICAST?
NO
YES
S920
IS SOURCE PHYSICAL ADDRESS OF PACKET PRESENT IN THE MANAGEMENT LIST?
YES
NO
S930
REGISTER SOURCE PHYSICAL ADDRESS IN MANAGEMENT LIST
S940
INITIALIZE TIMER
TRANSMIT PACKET TO UPPER LAYER
S950
END

FIG. 10


START
S1000
IS IT TIME TO CHECK MANAGEMENT LIST?
NO
YES
S1010
IS VALID ENTRY PRESENT?
NO
YES
S1020
DOES TIMER EXPIRE?
NO
S1040
INCREASE OR DECREASE TIMER
YES
S1030
CHANGE VALID ENTRY INTO INVALID STATE

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 10 2804

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 2002/061009 A1 (SORENSEN JOHAN) 23 May 2002 (2002-05-23)	1,3-5,7, 9,12, 15-19, 22, 25-31, 35-41, 43, 46-48, 51,52,54	H04L12/64
A	* abstract *	2,6,8, 10,11, 13,14, 20,21, 23,24, 32-34, 42,44, 45,49, 50,53	
	* paragraphs [0008], [0020], [0021], [0033], [0034] * * figure 3 *		TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	US 2003/065816 A1 (ANDREWS MICHAEL B ET AL) 3 April 2003 (2003-04-03) * paragraphs [0031], [0035] * * figures 2A,2B *	1-54	H04L
Y	EP 1 265 420 A (NOKIA CORP) 11 December 2002 (2002-12-11) * abstract * * paragraphs [0002] - [0004], [0008], [0022], [0026], [0027], [0030] *	1-54	
Y	EP 1 091 532 A (MICROSOFT CORP) 11 April 2001 (2001-04-11) * paragraphs [0059], [0060] * * figure 6 *	1-54	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 September 2004	Ramenzoni, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

& : member of the same patent family, corresponding document

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 10 2804

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 5 452 291 A (EISENHANDLER SANFORD ET AL) 19 September 1995 (1995-09-19) * abstract * * column 1, line 17 - line 31 * * column 4, line 50 - line 68 * * figures 4,6,10 * -----	1,3-5, 7-9,18, 19,27, 36,37,47	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 September 2004	Ramenzoni, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 10 2804

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15-09-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002061009 A1	23-05-2002	AU 2426702 A	03-06-2002
		WO 0243333 A2	30-05-2002
US 2003065816 A1	03-04-2003	NONE	
EP 1265420 A	11-12-2002	US 2002194353 A1	19-12-2002
		CN 1391384 A	15-01-2003
		EP 1265420 A2	11-12-2002
EP 1091532 A	11-04-2001	US 6674767 B1	06-01-2004
		EP 1091536 A2	11-04-2001
		EP 1091532 A2	11-04-2001
US 5452291 A	19-09-1995	JP 7177160 A	14-07-1995

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82